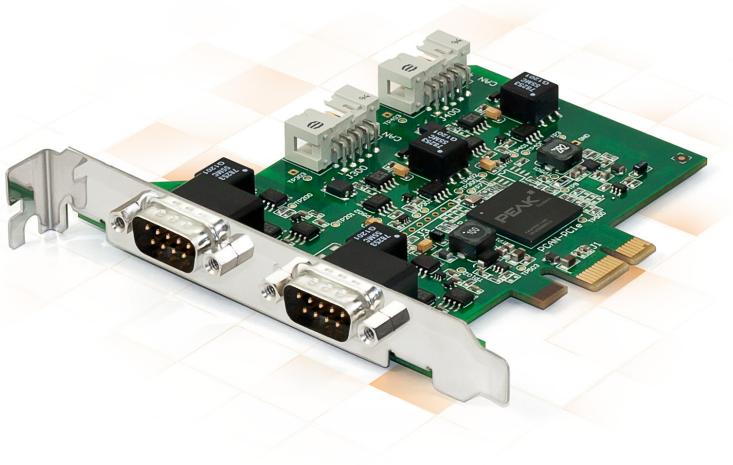
PCAN-PCI Express

CAN Interface for PCI Express

User Manual



Document version 3.4.0 (2015-06-09)

PEAK System

Products taken into account

Product Name	Model	Part Number	Ser. No.
PCAN-PCI Express Single Channel galv. isolated	One CAN channel	IPEH-003026	starting at 01000
PCAN-PCI Express Dual Channel galv. Isolated	Two CAN channels	IPEH-003027	
PCAN-PCI Express Four Channel galv. isolated	Four CAN channels	IPEH-003040	

The cover picture shows the product PCAN-PCI Express Four Channel galvanic isolated. Other product versions have an identical form factor but vary in equipment.

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1 Introduction

The PCAN-PCI Express card enables the connection of a PC with PCI Express slots to CAN networks. There is galvanic isolation of up to 500 Volts between the computer and CAN sides. The card is available as a single, dual, or four-channel version. Device drivers and programming interfaces exist for different operating systems, so programs can easily access a connected CAN bus.

Tip: At the end of this manual (Appendix C) you can find a Quick Reference with brief information about the installation and operation of the PCAN-PCI Express card.

1.1 Properties at a Glance

- PC plug-in card (PCIe-x1) for PCI Express slots
- 1, 2 or 4 High-speed CAN channels (ISO 11898-2)
- Bit rates from 5 kbit/s up to 1 Mbit/s
- Compliant CAN specifications 2.0A (11-bit ID) and 2.0B (29-bit ID)
- CAN bus connection via D-Sub, 9-pin (in accordance with CiA® 102)
- FPGA implementation of the CAN controller (SJA1000 compatible)
- NXP PCA82C251 CAN transceiver
- Galvanic isolation on the CAN connection up to 500 V, separate for each CAN channel
- 5-Volt supply to the CAN connection can be connected through a solder jumper, e.g. for external bus converter

- Extended operating temperature range from -40 to 85 °C (-40 to 185 °F)

Note: This manual describes the use of the PCAN-PCI Express card with **Windows**. You can find device drivers for **Linux** and the corresponding application information on the provided DVD in the directory branch `Develop` and on our website under www.peak-system.com/linux.

1.2 System Requirements

- A vacant PCI Express slot in the computer
- Operating system Windows 8.1, 7, Vista (32/64-bit) or Linux (32/64-bit)

1.3 Scope of Supply

- PCAN-PCI Express card
- Slot bracket with D-Sub connectors for the CAN bus (only four-channel version)
- Device drivers for Windows 8.1, 7, Vista and Linux (32/64-bit)
- PCAN-View CAN monitor for Windows 8.1, 7, Vista (32/64-bit)
- PCAN-Basic programming interface consisting of an interface DLL, examples, and header files for all common programming languages
- Manual in PDF format

2 Installing the Software and the Card

This chapter covers the software setup for the PCAN-PCI Express card (short: PCIe card) under Windows and the installation of the card in the computer.

Setup the driver before installing the PCIe card.

Do the following to install the driver:

1. Insert the supplied DVD into the appropriate drive of the computer. Usually a navigation program appears a few moments later. If not, start the file `Intro.exe` from the root directory of the DVD.
2. Select in the main menu **Drivers**, and then click on **Install now**.
3. Confirm the message of the User Account Control in relation to "Installer Database of PEAK Drivers".

   The setup program for the driver is started.
4. Follow the instructions of the program.

Do the following to install the PCIe card into the computer:

Attention! Electrostatic discharge (ESD) can damage or destroy components on the PCAN-PCI Express card. Take precautions to avoid ESD when handling the card.

1. Four-channel version only: Connect the 10-pin connector of CAN ports 3 and 4 with a cable from the slot bracket.

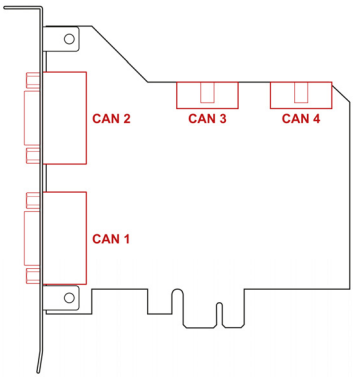

Figure 1: Position of the sockets for the CAN connection, CAN 3 (upper left position), CAN 4 (upper right position)

2. Shut down the computer and switch it off.
3. Disconnect the computer from the power supply.
4. Open the computer's casing.
5. If applicable, remove a front blind in front of the desired slot of the PCIe card. The additional slot bracket with connectors used by the four-channel version needs a further place.
6. Insert the PCIe card into a vacant PCI Express slot. For details refer to the documentation of the computer.
7. Close the computer's casing.
8. Reconnect the power supply of the computer.

Do the following to complete the initialization:

1. Turn on the computer and start Windows. Make sure again that you are logged in as user with administrator privileges.

   Windows notifies that new hardware has been detected. The drivers are found and installed by Windows.

After the initialization process is finished successfully you can find the entry “PCAN-PCI Express” in the branch “CAN-Hardware” of the Windows Device Manager.

3 Connecting the CAN Bus

3.1 D-Sub connector

A High-speed CAN bus (ISO 11898-2) is connected to the 9-pin D-Sub connector. The pin assignment for CAN corresponds to the specification CiA® 102.

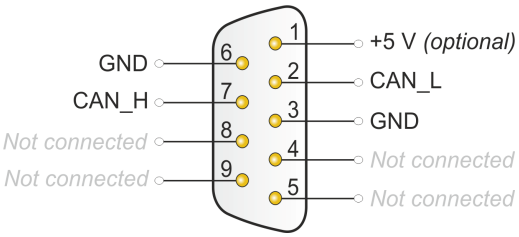

Figure 2: Pin assignment of High-speed CAN connection
(view onto a male connector on the PCAN-PCI Express card)

With pin 1 devices with low power consumption (e.g. bus converters) can be directly supplied via the CAN connector. At delivery this pin is not assigned. You can find a detailed description in the following section 3.2.

Tip: You can connect a CAN bus with a different transmission standard via a bus converter. PEAK-System offers different bus converter modules (e.g. PCAN-TJA1054 for a Low-speed CAN bus according to ISO 11898-3).

The pin assignment between the D-Sub port and the 10-pin connector on the PCAN-PCI Express Four Channel card for channel 3 and 4 is as follows:

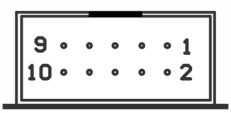

Figure 3: Numbering at the 10-pin connector

Pin	Assignment	Assignment D-Sub
1	+5 V (optional)	1
2	GND	6
3	CAN_L	2
4	CAN_H	7
5	GND	3
6	not connected	8
7	not connected	4
8	not connected	9
9	not connected	5
10	not connected	

3.1.1 Slot Bracket with D-Sub Connectors

Figure 4: Dual channel slot bracket

Four-channel version only: To connect a CAN bus to the PCAN-PCI Express card, use the supplied slot bracket. After you have connected the cables from the slot bracket with the 10-pin sockets of CAN port 3 and 4, you can connect the CAN busses with the D-Sub sockets.

3.2 Supplying External Devices via the CAN Connector

A 5-Volt supply can optionally be routed to pin 1 of a D-Sub connector by setting solder bridges on the PCAN-PCI Express card (independently for each connector on the dual or four-channel version). Thus external devices with low power consumption (e.g. bus converters) can be directly supplied via the CAN connector. By using interconnected DC/DC converter the current output is limited to 50 mA.

➡ Proceed as follows to activate the 5-Volt supply:

Attention! Electrostatic discharge (ESD) can damage or destroy components on the PCAN-PCI Express card. Take precautions to avoid ESD when handling the card.

Set the solder bridge(s) on the PCIe card according to the desired settings. During this procedure take especially care not to produce unwanted short circuits on the card.

Figure 5 shows the positions of the solder fields on the PCIe card. The table below contains the possible settings.

Figure 5: Position of the solder fields on the board's bottom side for a 5-Volt supply at the CAN connection

5-Volt supply →	Jumper	None	Pin 1
CAN 1	JP100		
CAN 2	JP200		
CAN 3	JP300		
CAN 4	JP400		

Attention! Risk of short circuit! If the option described in this section is activated, you may only connect or disconnect CAN cables or peripheral systems (e.g. bus converters) to or from the PCIe card while the computer is de-energized.

3.3 Cabling

3.3.1 Termination

A High-speed CAN bus (ISO 11898-2) must be terminated on both ends with 120 Ohms. Otherwise, there are interfering signal reflections and the transceivers of the connected CAN nodes (CAN-interface, control device) will not work.

The PCAN-PCI Express card does not have an internal termination. Use the card on a terminated CAN bus.

3.3.2 Example of a Connection

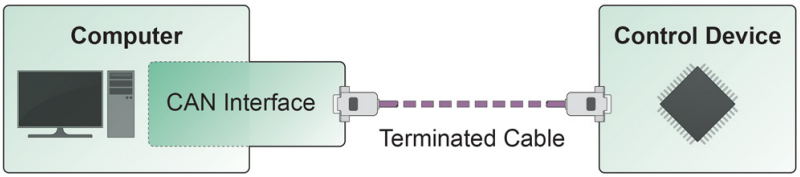

Figure 6: Simple CAN connection

In this example, the PCAN-PCI Express card is connected with a control unit by a cable that is terminated at both ends.

3.3.3 Maximum Bus Length

High-speed CAN networks may have bit rates of up to 1 Mbit/s. The maximum bus length depends primarily on the bit rate.

The following table shows the maximum possible CAN bus length at different bit rates:

Bit rate	Bus length
1 Mbit/s	40 m
500 kbit/s	110 m
250 kbit/s	240 m
125 kbit/s	500 m
50 kbit/s	1.3 km
20 kbit/s	3.3 km
10 kbit/s	6.6 km
5 kbit/s	13.0 km

The listed values have been calculated on the basis of an idealized system and can differ from reality.

4 Software and API

This chapter covers the provided software PCAN-View and the programming interface PCAN-Basic.

4.1 Monitor Software PCAN-View

PCAN-View is simple Windows software for viewing, transmitting, and logging CAN- and CAN FD messages.

Note: This chapter describes the use of PCAN-View with a CAN adapter.

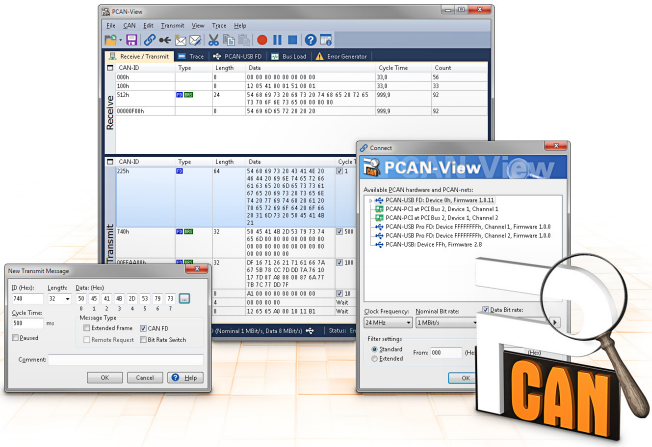

Figure 7: PCAN-View for Windows

Do the following to start and initialize PCAN-View:

1. Open the Windows Start menu or the Windows Start page and select **PCAN-View**.

   The dialog box for selecting the hardware and for setting the parameters appears.

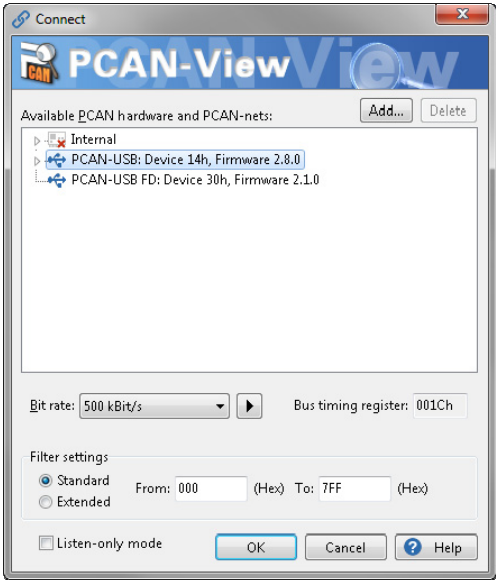

Figure 8: Selection of the hardware and parameters

2. From the list **Available PCAN hardware,** select the desired interface to be used.
3. Select the bit rate that is used by all nodes on the CAN bus from the drop-down list **Bit rate**. Use the button to the right of the drop-down list to create User-defined bit rates.
4. Under **Filter settings** you can limit the range of CAN IDs to be received, either for standard frames (11-bit IDs) or for extended frames (29-bit IDs).

5. Activate the **Listen-only mode** if you do not actively participate in the CAN traffic and just want to observe. This also avoids an unintended disruption of an unknown CAN environment (e.g. due to different bit rates).
6. Finally, confirm the settings in the dialog box with **OK**. The main window of PCAN-View appears (see Figure 9).

4.1.1 Receive/Transmit Tab

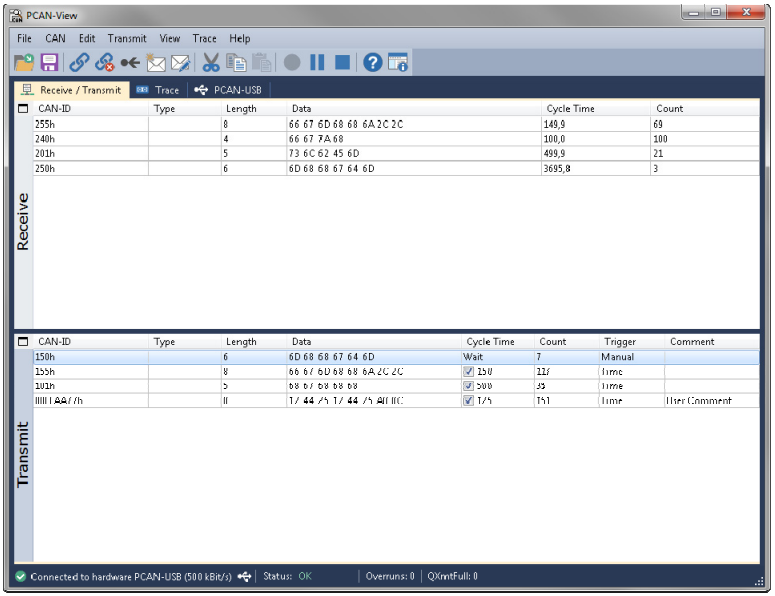
PCAN-View
File CAN Edit Transmit View Trace Help
Receive / Transmit
Trace
PCAN-USB
CAN-ID Type Length Data Cycle Time Count
255h 8 66 67 6D 68 68 6A 2C 2C 149,9 69
240h 4 66 67 7A 68 100,0 100
201h 5 73 6C 62 45 6D 499,9 21
250h 6 6D 68 68 67 64 6D 3695,8 3
Receive
CAN-ID Type Length Data Cycle Time Count Trigger Comment
150h 6 6D 68 68 67 64 6D Wait 7 Manual
Transmit
Connected to hardware PCAN-USB (500 kBit/s)
Status: OK
Overruns: 0
QXmtFull: 0

Figure 9: Receive/Transmit Tab

The Receive/Transmit tab is the main element of PCAN-View. It contains two lists, one for received messages and one for the transmit messages. Representation of CAN data is in hexadecimal format.

- Do the following to transmit a CAN message with PCAN-View:

1. Select the menu command **Transmit** > **New Message** (alternatively or Ins).

   The dialog box **New Transmit Message** is shown.

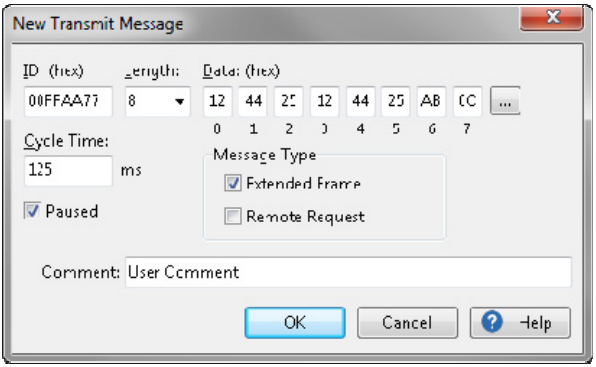

Figure 10: Dialog box new transmit message

2. Enter the ID and the data for the new CAN message.
3. The field **Cycle Time** indicates if the message shall be transmitted manually or periodically. If you want to transmit the message periodically, you must enter a value greater than 0. For a manual-only transmission enter 0.
4. Confirm the entries with **OK**.

   The created transmit message appears on the **Receive/Transmit** tab.
5. You trigger selected transmit messages manually with the menu command **Transmit** > **Send** (alternatively Space bar). The manual transmission for CAN messages being transmitted periodically is carried out additionally.

Tip: Using the menu command **File** > **Save** the current transmit messages can be saved to a list and loaded for reuse later on.

4.1.2 Trace Tab

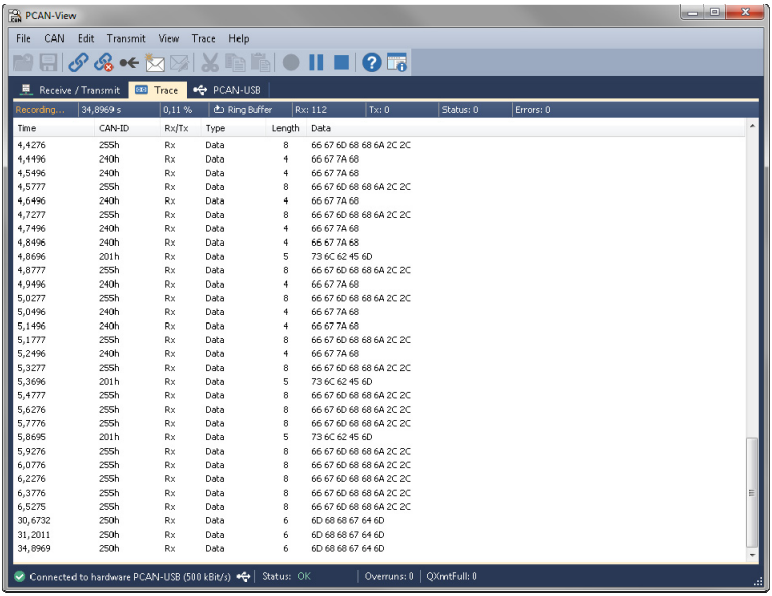

Figure 11: Trace Tab

On the Trace tab the data tracer of PCAN-View is used for logging the communication on a CAN bus. During this process the CAN messages are cached in the working memory of the PC. Afterwards they can be saved to a file.

The tracer can be configured to run in linear or in ring buffer mode. In linear buffer mode the logging is stopped as soon as the buffer is filled completely. In ring buffer mode the oldest messages are overwritten by incoming ones.

4.1.3 PCAN-PCI Express Tab

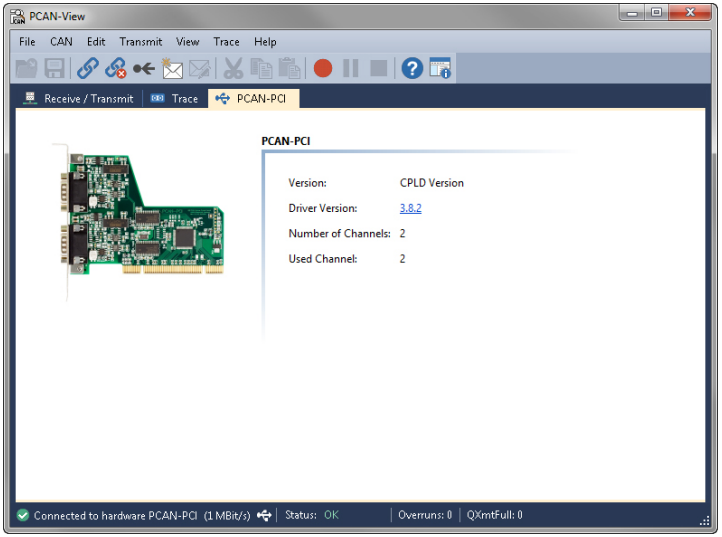

Figure 12: PCAN-PCI tab (example)

On the PCAN-PCI Express tab various information about your hardware is displayed, like the current device driver version.

4.1.4 Status Bar

Figure 13: Display of the Status Bar

The status bar shows information about the current CAN connection, about error counters (Overruns, QXmtFull) and shows error messages.

You can find further information about the use of PCAN-View in the help which you can invoke in the program via the menu **Help** or the F1 key.

4.2 Linking Own Programs with PCAN-Basic

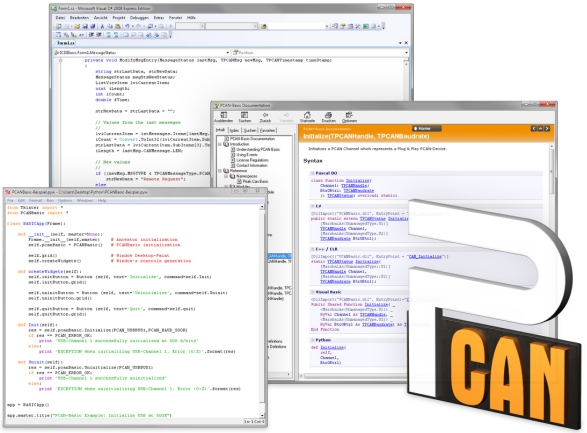

Figure 14: PCAN-Basic

On the provided DVD you can find files of the programming interface PCAN-Basic in the directory branch `Develop`. This API provides basic functions for linking own programs to CAN- and CAN FD interfaces by PEAK-System and can be used for the following operating systems:

- Windows 8.1, 7, Vista (32/64-bit)
- Windows CE 6.x (x86/ARMv4)
- Linux (32/64-bit)

The API is designed for cross-platform use. Therefore software projects can easily ported between platforms with low efforts. For all common programming languages examples are available.

Beginning with version 4, PCAN-Basic supports the new CAN FD standard (CAN with Flexible Data Rate) which is primarily characterized by higher bandwidth for data transfer.

4.2.1 Features of PCAN-Basic

- API for developing applications with CAN and CAN FD connection
- Access to the CAN channels of a PCAN-Gateway via the new PCAN-LAN device type
- Supports the operating systems Windows 8.1, 7, Vista (32/64-bit), Windows CE 6.x, and Linux (32/64-bit)
- Multiple PEAK-System applications and your own can be operated on a physical channel at the same time
- Use of a single DLL for all supported hardware types
- Use of up to 16 channels for each hardware unit (depending on the PEAK CAN interface used)
- Simple switching between channels of a PEAK CAN interface
- Driver-internal buffer for 32,768 messages per CAN channel
- Precision of time stamps on received messages up to 1 µs (depending on the PEAK CAN interface used)
- Supports PEAK-System's trace formats version 1.1 and 2.0 (for CAN FD applications)
- Access to specific hardware parameters, such as listen-only mode
- Notification of the application through Windows events when a message is received
- Extended system for debugging operations
- Multilingual debugging output
- Output language depends on operating system
- Debugging information can be defined individually

An overview of the API functions is located in the header files. You can find detailed information about the PCAN-Basic API on the provided DVD in the text and help files (file name extensions `.txt` and `.chm`).

4.2.2 Principle Description of the API

The PCAN-Basic API is the interface between the user application and device driver. In Windows operating systems this is a DLL (Dynamic Link Library).

The sequence of accessing the CAN interface is divided into three phases:

1. Initialization
2. Interaction
3. Completion

Initialization

A channel must be initialized before using it. This is done by the simple call of the function `CAN_Initialize` for CAN and `CAN_InitializeFD` for CAN-FD. Depending on the type of the CAN hardware, up to 16 CAN channels can be opened at the same time. After a successful initialization the CAN channel is ready for communication with the CAN hardware and the CAN bus. No further configuration steps are required.

Interaction

For receiving and transmitting messages the functions `CAN_Read` and `CAN_Write` as well as `CAN_ReadFD` and `CAN_WriteFD` are available. Additional settings can be made, e.g. setting up message filters to confine to specific CAN IDs or setting the CAN controller to listen-only mode.

When receiving CAN messages, events are used for an automatic notification of an application (client). This offers the following advantages:

- The application no longer needs to check for received messages periodically (no polling).
- The response time at reception is reduced.

Completion

To end the communication the function `CAN_Uninitialize` is called in order to release the reserved resources for the CAN channel, among others. In addition the CAN channel is marked as "Free" and is available to other applications.

4.2.3 Notes about the License

Device drivers, the interface DLL, and further files needed for linking are property of the PEAK-System Technik GmbH and may be used only in connection with a hardware component purchased from PEAK-System or one of its partners. If a CAN hardware component of third-party suppliers should be compatible to one of PEAK-System, then you are not allowed to use or to pass on the driver software of PEAK-System.

If a third-party supplier develops software based on the PCAN-Basic and problems occur during the use of this software, consult the software provider.

5 Technical Specifications

Connectors	
Computer	PCI Express x1 (1 Lane), Specification 1.1
CAN	D-Sub (m), 9 pins Pin assignment according to specification CiA® 102

CAN	
Specification	ISO 11898-2, High-speed CAN 2.0A (standard format) and 2.0B (extended format)
Bit rates	5 kbit/s - 1 Mbit/s
Controller	FPGA implementation (SJA1000 compatible)
Transceiver	NXP PCA82C251
Galvanic isolation	up to 500 V, separate for each CAN channel
Supplying external devices	D-Sub pin 1; 5 V, max. 50 mA not assigned at delivery
Termination	none

Measures	
Size	PCB: 121 x 114 mm (H x W) See also dimension drawing in Appendix B on page 31
Weight	PCAN-PCI Express Single Channel: 55 g PCAN-PCI Express Dual Channel: 66 g PCAN-PCI Express Four Channel: 73 g

Power supply			
Current consumption		at 3.3-V pin	at 12-V pin
	Product version		
	Single Channel:	265 mA	max. 50 mA
	Dual Channel:	265 mA	max. 80 mA
	Four Channel:	300 mA	max. 150 mA

Continued on the next page

Environment	
Operating temperature	-40 - +85 °C
Temperature for storage and transport	-40 - +125 °C
Relative humidity	15 - 90 %, not condensing
EMC	EN 55024:2011-09 EN 55022:2011-12 EC directive 2004/108/EG

Appendix A CE Certificate

PCAN-PCI Express IPEH-003026/27/40 – EC Declaration of Conformity
PEAK-System Technik GmbH

Notes on the CE Symbol CE

The following applies to the "PCAN-PCI Express" product with the item number(s) IPEH-003026/27, serial numbers starting at 01000, and IPEH-003040.

EC Directive This product fulfills the requirements of EU EMC Directive 2004/108/EG (Electromagnetic Compatibility) and is designed for the following fields of application as for the CE marking:

Electromagnetic Immunity
DIN EN 55024, publication date 2011-09
Information technology equipment – Immunity characteristics – Limits and methods of measurement (CISPR 24:2010);
German version EN 55024:2010

Electromagnetic Emission
DIN EN 55022, publication date 2011-12
Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement (CISPR 22:2008, modified);
German version EN 55022:2010

Declarations of Conformity In accordance with the above mentioned EU directives, the EC declarations of conformity and the associated documentation are held at the disposal of the competent authorities at the address below:

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Mr. Wilhelm
Otto-Roehm-Strasse 69
64293 Darmstadt
Germany

Phone: +49 (0)6151 8173-20
Fax: +49 (0)6151 8173-29
E-mail: info@peak-system.com

Signed this 22nd day of October 2013

Appendix B Dimension Drawing

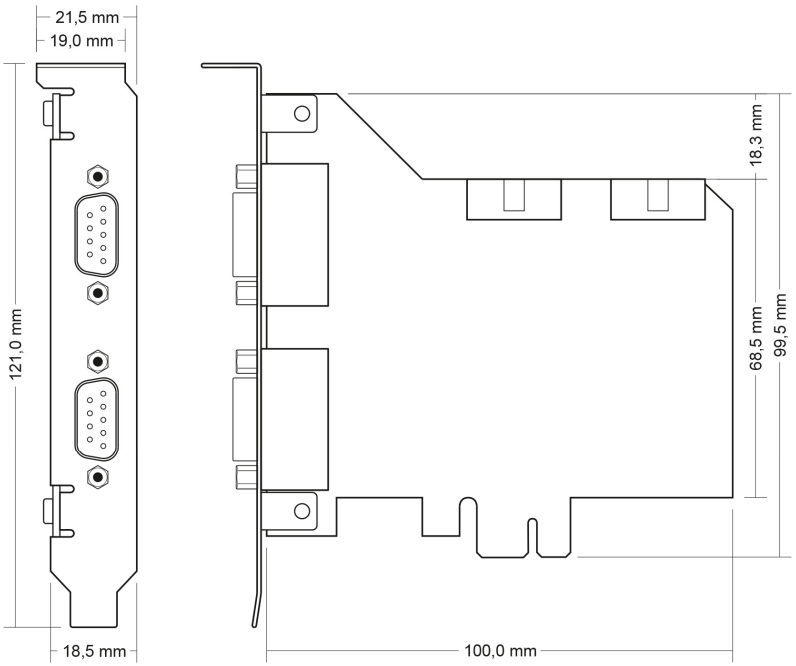

Figure 15: Dimension drawing PCAN-PCI Express

The figure does not show the actual size of the product.

Appendix C Quick Reference

Software/Hardware Installation under Windows

Before installing the PCAN-PCI Express card into the computer set up the corresponding software package from the supplied DVD (with administrator privileges). Afterwards, insert the PCIe card into a vacant PCI Express slot of the switched off computer. The PCIe card is recognized by Windows and the driver is initialized. After the installation process is finished successfully you can find the entry "PCAN-PCI Express" in the branch "CAN-Hardware" of the Windows Device Manager.

Getting Started under Windows

Run the CAN monitor PCAN-View from the Windows Start menu as a sample application for accessing the PCAN-PCI Express card. For initialization of the PCIe card select the desired CAN channel and the CAN bit rate.

High-speed CAN connector (D-Sub, 9 pins)